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Discussions

Interactive comment on "Warm Paleocene/Eocene climate as simulated in ECHAM5/MPI-OM" *by* M. Heinemann et al.

Anonymous Referee #3

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Review of "Warm Paleocene/Eocene climate as simulated in ECHAM5/MPI-OM" by M. Heinemann, J. H. Jungclaus, and J. Marotzke

(Note: I have written this review prior to reading other posted reviews of this paper.)

Overview:

This paper presents results from a new coupled climate modeling study of the late Paleocene – early Eocene (PE). The study also examines the factors that contribute to differences between the PE experiment, and a present day coupled experiment using a simple energy balance model. The authors find that much of the difference in surface temperature between the present-day and PE experiments can be attributed to differences in radiative forcing, thus supporting the hypothesis that warm high latitude

temperatures during the PE were due to radiative effects – not enhanced meridional heat transport. Overall, this paper is very well written. The section detailing the analysis with the EBM and comparison between the present day and PE experiments is particularly well done. While the results are not surprising or unexpected, they do provide a clear theoretical analysis to support other studies that suggest that meridional transport does not explain high latitude temperatures at the PETM or in the early Eocene (e.g., Huber and Sloan, 2001).

Major Comments:

Near line 23, the authors state: "In this study, we aim at reducing this gap between modeling and proxy data for the late Paleocene/early Eocene(PE)..." However, the paper presents very little comparison between PE model results and proxies – It is also not clear what parameterizations in the model allow for the improvement over previous fully-coupled modeling studies. Given that this is the first PE experiment in ECHAM5, I expected some comparison with other early Eocene coupled modeling studies – particularly Huber and Sloan (2001), which was also run with a background pCO_2 of 560 ppm. Figure 5 suggests that ECHAM5 produces temperatures at 560ppm in the high latitudes that (while still below those of proxies), are significantly higher than experiments run in the NCAR CSM at 560ppm (Huber and Sloan, 2001), and are comparable to temperatures in higher pCO_2 experiments (2240ppm) in the NCAR CCSM3 (Shellito et al, 2009). What is different about ECHAM5?

In the last paragraph, the equable climate of this simulation (PE) is attributed to topography, surface albedo, and effective longwave emissivity. If this is the case, as other models also account for these effects, why is it that ECHAM5 can produce such an equable climate at 560ppm CO_2? I'm not sure it is within the scope of this paper to go into a full analytical comparison with other models here, but it must be mentioned.

Finally, zonal mean annual SSTs in the model are only compared with six PE SST proxies. Why only these six? (If the intention is to focus on recent estimates, there should be a reference to Hollis et al., 2009). Also, a bit more detail in the comparison to terrestrial proxies in section 3.2 would certainly strengthen this paper.

Minor comment:

The Arctic in this Eocene configuration in connected to other basins via shallow sills. What sort of transport is there across these sills? Does this play any role in Arctic temperature? (I expect this is minor. Or, perhaps this will be examined thoroughly in another paper?)

References:

Hollis, C. J. et al., 2009: Tropical sea temperatures in the high-latitude South Pacific during the Eocene. Geology, February 2009, v. 37, no. 2, p. 99-102, doi:10.1130/G25200A.1

Huber, M., and L. C. Sloan, 2001: Heat transport, deep waters, and thermal gradients: Coupled simulation of an Eocene greenhouse climate. Geophys. Res. Lett., 28, 3481-3484.

Shellito, C. J., J.-F. Lamarque, and L. C. Sloan, 2009: Early Eocene Arctic climate sensitivity to pCO2 and basin geography. Geophys. Res. Lett., 36, L09707, doi:10.1029/2009GL037248

Interactive comment on Clim. Past Discuss., 5, 1297, 2009.